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ABSTRACT

These five serial issues focus on the outcomes of developmental education. Featured are the following articles: (1) "Developmental Instruction: What Really Makes a Difference?" by Hunter R. Boylan, which reviews several research-based models or theories of learning, including the Carroll model, the Bloom model, and the Bruner model, and discusses the components of effective instruction, including clarity of objectives, emphasis on mastery, accommodation to learning styles, time on task, feedback for learning, and prerequisite skills; (2) "The Effects of a Skills Versus Discussion Approach on Reading and Thinking," by Joan Bartlett, which compares the effectiveness of the two instructional approaches on reading comprehension; (3) "The Effectiveness of Developmental Education Programs," by Boylan, which reviews recent studies of the effects of developmental education on students' grade point averages, retention rates, gain scores, and other factors; and (4) "Facts, Figures, and Guesses about Developmental Education Programs, Personnel, and Participation," by Boylan, which reviews the few existing statistics on developmental education, including the number of faculty involved, and the number of students participating. (DJD)

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Research in Developmental Education

Volume I
Issue 2

DEVELOPMENTAL INSTRUCTION

What Really Makes a Difference?

By: Hunter R. Boylan

Every so often, we read a book or an article or listen to a conference presentation on some new instructional technique. And, if we've done this reading or listening for very many years, we are bound to be a bit skeptical. New instructional "systems" seem to be constantly proliferating with each one offering the hope of solving all the problems we encounter in the classroom. R. E. Snow alluded to this situation when he referred to research on teaching and learning as a "... walk through the panacea garden (1980)." Yet most of those who design innovative instructional systems are quick to point out that such systems are not supposed to be panaceas. At best, they are supposed to represent improvements over traditional instructional practice. The skepticism of an intelligent consumer of educational literature is based on the realization that new instructional systems will probably solve some problems. They will also leave other problems unresolved and, in some cases, create new problems.

When looking at new instructional systems, it is important to recognize that they all have limitations as well as strengths. And the ones with the best chances for making a positive difference in learning are those derived from research-based theory. While even these have limitations, a knowledge of the theory on which instructional systems are based will be useful in determining what these limitations may be before implementating new instructional techniques. This is particularly helpful since very few theories of learning take into account the specific settings, circumstances, or students with whom developmental educators work.

This issue of RESEARCH IN DEVELOPMENTAL EDUCATION, therefore, will focus on various research-based models or theories of learning. The next issue will then review the implications of these theories for instructional practice. It is anticipated that, through this process, we can determine what really does make a difference in the success of developmental instruction.

LEARNING MODELS:

What is important

to learning?

What are the

variables

involved?

...AND MORE...

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THE CARROLL MODEL

One of the more influential models of learning was first proposed by J. B. Carroll in 1963. Carroll proposed a five part model in which he defined aptitude as the amount of time necessary for a student to master an objective under optimal conditions of learning. Given this definition, he proposed that "...nearly all pupils can learn what they are supposed to learn in school, given enough time (1970, p. 71)."

Carroll also suggested that students bring three entering behaviors into any instructional setting: 1. aptitude, 2) perseverance, and 3) ability to comprehend instruction. He defines perseverance as the amount of time students are willing to spend working on mastering a given objective. He defines ability to comprehend instruction as a combination of listening and other verbal and reasoning skills that enable students to make sense out of whatever information is presented to them.

These three entering behaviors of students are then influenced by two instructor behaviors: opportunity to learn and quality of in-

struction. Opportunity to learn refers to the amount of time allocated by the instructor to any given item of course content. Quality of instruction includes such things as the instructor's communication skills and ability to adjust instructional tasks to student characteristics.

This set of constructs is generally known as "mastery learning" and Carroll is credited as the originator of the mastery learning concept. In Carroll's model, learning is a function of the interaction between entering behaviors of students and the behaviors of their instructors. His definition of aptitude as a function of time rather than a function of performance measured by tests has been most influential for developmental educators. This definition suggests that all students can learn. It also suggests that instructors have a major responsibility for promoting learning and that they can exercize this responsibility by:

1. Allowing students to work at a pace appropriate to their aptitude

2. Clarifying objectives and providing precise instructions

3. Providing ample opportunity for students to work on specific objectives

4. Encouraging student persistence in working on specific objectives.

THE BLOOM MODEL

Benjamin Bloom's (1976) model of learning proposes that students enter the learning situation with two sets of characteristics - cognitive and affective. these characteristics are prerequisites to further learning. Cognitive characteristics include such things are reading comprehension and verbal skills. Affective characteristics include such things as attitude toward the subject matter or a general desire to learn. Both cognitive and affective characteristics can be task - specific in that reading skills may be required for mastering a specific learning objective while verbal skills may be required to master some other objective. Students may also have a positive attitude towards some aspects of a learning task and have negative attitudes towards some other aspects.

According to Bloom, students' cognitive and affective characteristics interact with the quality of instruction to produce various learning outcomes. Bloom considers quality instruction to consist of activities such as giving cues to students in terms of precise presentation and explanation; providing reinforcement for learning; and providing appropriate feedback for learning.

The learning outcomes proposed by Bloom include: 1) the level and type of student achievement, 2) the rate of student learning, and 3) change in students' affective behaviors. The first two learning outcomes are probably self-explanatory. The third outcome -- affective change -- refers to a variety of variety of attitudinal changes such as feelings about schooling in general or the subject matin particular or an improvement in academic self-concept.

Bloom shares Carroll's view of mastery learning to the extent that he argues that "...students become very similar with regard to learning ability, rate of learning, and motivation for further learning - when provided with favorable learning conditions (Bloom, 1976, p. 10)."

Like Carroll, Bloom would also argue that instructors have a major responsibility for student learning. The Bloom model would support all of the implications for instruction that are supported by the Carroll model and add the following:

1. Instructors should be sure that students are given some means of developing appropriate cognitive skills before the students are required to complete learning tasks involving those particular skills.

2. Instructors should insure that students have attained mastery of each learning objective before moving on to work on the next objective.

3. Since many cognitive skills are sequential (in that one builds upon another) learning tasks should be structured in terms of this sequence.

4. Instructurs should insure that students receive adequate reinforcement and feedback for learning.

THE BRUNER MODEL

In his book, Toward a Theory of Instruction, Jerome Bruner proposes a model based what he considers to be the four major requirements for learning (1966). These include:

Resourcery

The following books, articles, or monographs may be of interest to those who want further information on instructional theory and design.

Bloom, Benjamin S., HUMAN CHARACTERISTICS AND SCHOOL LEARNING, New York: McGraw-Hill, 1976.

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Milton, Ohmer et. al., ON COLLEGE TEACHING: A GUIDE TO CONTEMPORARY PRACTICES, San Francisco: Jossey-Bass, 1978.

Umstattd, J. G., COLLEGE TEACHING: BACKGROUND, THEORY AND PRACTICE, Washington, D.C.: University Press of Washington, D.C., 1964.

students. Such a summary is presented below.

COMPONENTS OF LEARNING MODELS

1) Since aptitude is a function of the amount of time required to master a given objective, variable pacing in learning activities is important.

2) Perseverance or the amount of time spent in mastering a given task is positively related to the amount of learning that takes place.

3) Clear objectives and precise instructions tend to facilitate student learning.

4) Providing opportunities for students to spend time practicing and completing learning tasks promotes learning.

5) Students should be provided with a means of developing cognitive skills before these skills are required in order to master course material.

6) Students should be able to master one learning task before proceeding to the next one.

7) Since cognitive skills are often sequential, learning tasks should be structured according to some sequence of cognitive difficulty.

8) Adequate feedback and reinforcement is a necessary component of effective learning.

9) Since a predisposition to learn is a necessary prerequisite to learning, instructors have a major role in encouraging this predisposition.

10) Assessment of students' individual cognitive styles is useful for designing instructional activities.

11) Learning activities should be designed on the basis of: a) the competencies necessary to complete the activity and, b) the level of competence desired as a result of having completed these activities.

12) Learning activity should be assessed in terms of specific competencies rather than in terms of normative tests.

13) Instructors should pay careful attention to the structure of courses and learning activities since this structure is influential in helping students to organize, comprehend, and use course information.

While this is, by no means, a complete listing of all the components of the various models discussed here, it does include most of the major points of each model. As such, it should serve as a useful reference for the design of instruction. In the next issue of RESEARCH IN DEVELOPMENTAL EDUCATION, we will look at instructional systems and how well they meet the criteria set forth in various models of learning.

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1) encouraging a predisposition to learning among students, 2) providing a clear structure for the material to be taught, 3) organizing presentaion of materials according to a sequence consistent with this structure, and 4) specifying and applying reinforcement for learning.

Bruner's conception of a predisposition to learning is similar to the concept of motivation. Before learning can take place, students must want to learn. Bruner believes that this desire to learn may be stimulated by challenging students' ideas, providing clear-cut goals, and reinforcing the relevance of material already learned.

He also believes that the structure of the learning process helps to promote effective learning. Bruner considers structure to include such things as the way in which material is presented, the amount of information that students must retain, and the capacity of instruction to generate new ideas. Course structure should serve to simplify information and encourage students to assemble information in new configurations. He refers to these three dimensions as "mode," "economy," and "power" (Bruner, 1966, p. 44).

Bruner believes that the "mode" of presentation may involve what he calls "enactive" representation, "iconic" respresentation, or "symbolic" representation (1966, p. 45). Enactive refers to student actions, iconic refers to images, and symbolic refers to abstractions governed by laws or rules. These three modes not only serve as a basis for structuring the learning experience, they also serve as a basis for organizing the sequence of instructional activity. While it is not always possible or desireable to do so, instruction should usually move the student in sequence from the enactive mode to the symbolic mode. Bruner also sets forth a variety of other criteria for sequencing of course material and presentation. He admits, however, that there is no single optimum sequence for all students. The appropriate sequence for learning activities will, in Bruner's view, have to be determined by further research and experience.

The manipulation of reinforcement is also an important instructional task for Bruner. In his words, "Learning depends upon knowledge of results at a time and at a place where knowledge can be used for correction (Bruner, 1966, p. 50)." It is incumbent upon the instructor, therefore, to provide such feedback at the appropriate moment in which it will have the greatest impact on learning.

Bruner's model is consistent with other models discussed here in that he notes the importance of such considerations as clarifying instructional objectives, structuring and sequencing course material, and providing reinforcement. Perhaps more than other theorists, however, he emphasizes the instructor's role in stimulating students' desire to learn.

THE GLASER MODEL

Robert Glaser proposed a model of instruction that includes four major components: 1) analyzing the level and type of skill to be developed, 2) determining the skill levels of individual students, 3) identifying the conditions necessary to move students from current skill levels to desired skill levels, and 4) assessing both the short and the long-term outcomes of instruction (Glaser, 1976). With its emphasis on assessing required competencies and building competence through instruction, Glaser's model was very influential in the competency-based learning movement.

He proposed that each learning task should be analyzed to determine what competencies are required to master the task and what skills will be developed as a result of mastering that task. This analysis should then serve as a basis for organizing instructional activities.

Glaser is also a strong advocate of student assessment. He suggests that good teaching is based on a full understanding of student characteristics that will influence learning. These include such things as cognitive style, general mediating abilities, and prior learning. Assessment of these characteristics enables the instructor to adjust learning activities to the individual needs of students.

The third component of Glaser's model is identifying and implementing conditions that are conducive to learning or the development of competence. He proposes that many of these conditions are instructor-controlled. He agrees with Bruner, for instance, that

Continued, over

the structure of the learning experience should make it easier for students to comprehend complex information. He also suggests that contingencies for reinforcement of learning should be built into any instructional program.

Finally, Glaser suggests that norm-referenced measurement of student progress is an inadequate test of student learning. He proposes, instead, that assessment should include criterion-referenced testing that measures student mastery against specific learning objectives or competencies. He also suggests that learning outcomes include not only immediate mastery but long term gains measured by general behavior patterns or enhanced ability for mastering new tasks.

Glaser's model adds several notions to the concept of instructional design. All of these have ramifications for the classroom teacher. In addition to the components suggested by other theorists, Glaser's model stresses the importance of:

1. Assessing students' individual cognitive styles as a guide to instructional design

2. Designing learning activities on the basis of competencies required and competencies desired

3. Evaluating student performance against these competencies as opposed to normative standards.

SUMMARY AND CONCLUSIONS

Although all the models of learning presented here share common characteristics, each model also adds its own set of contributions to understanding of the learning process. Each of the models also has its own emphasis based on whatever the author considers to be most important to the learning process. Haertel, Walberg, and Weinstein (1983), in their own review of these and other learning models, suggest that the theories of Bloom and Carroll and those of Bruner and Glaser differ sharply in their conception of what is most important to learning. The Bloom and Carroll models focus on the amount and quality of instruction. The Bruner and Glaser models tend to focus on other variables within the learning process and pay more attention to cognitive input and outcomes.

If we assume that each of these models represents some share of "The Truth" about the learning process, then a summary of the major components of these models may be useful in designing instruction for developmental

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Research in Developmental Education

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Number 3

DEVELOPMENTAL INSTRUCTION

What Really Makes a Difference?

By: Hunter R. Boylan

In the last issue of RiDe, several major theories of instruction were considered. These included the work of Bloom, Bruner, Carroll and Glaser. On the basis of this review, a summary of theory - based components of effective instruction was developed. The original summary included thirteen components. By eliminating the overlap in the work of various theorists, this list of components may be reduced to the following six.

1) Clarity of Objectives. Clearly-stated objectives and precise instructions regarding what is expected of students are extremely important to effective learning (Bloom, 1976, and Carroll, 1963).

2) Emphasis on Mastery. Since aptitude is a function of the amount of time required to master a given objective, opportunities should be provided for students to work at their own pace (Carroll, 1963).

3) Accomodation to Learning Styles. Each student has a unique style of approaching learning and a unique way of processing this information. Effective learning is usually facilitated when these styles are identified and taken into account in designing learning experiences (Bloom, 1976).

4) Time on Task. Since the amount of time students spend in learning tasks is directly related to the amount of learning that takes place, time for task mastery should be structured into the learning experience (Carroll, 1963).

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Six specific components of instruction help students with poor academic records improve their performance

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5) Feedback for Learning. Information on what was done right or wrong is an important part of the learning process. Providing opportunities for such feedback on a regular and consistent basis will enhance student learning (Bloom, 1976, Bruner, 1966 and Glaser, 1976).

6) Prerequisite Skills. Certain prerequisite skills must be mastered before students can be exected to master other, more complex skills. It is important to identify these skills and to make sure that students have an opportunity to develop them before they are needed in order to comprehend more complex material (Bloom, 1976 and Glaser, 1976.

These six theory-based components of effective instruction would appear to form a sound basis for instructional design. Yet, while all these components have merit for instructional design, some are more relevant to developmental students than others. A substantial body of literature exists on the impact of various instructional components on specific types of students. While it is impossible to review much of this literature here, a consideration of research on the components that have specific relevance for the developmental student should be useful as a guide to the practitioner. The comments which follow, therefore, are designed to identify components of instruction that may have an impact on developmental students and to discuss how these components should be used to improve learning for developmental students.

OBJECTIVES

The importance of clear and precise instructional objectives as aids to lear-

ning is well known. It is quite possible that such clarity and precision is even more important for developmental students than for others. In many cases, students served by developmental programs are those who have not learned that knowledge has a structure and that some pieces of information are more important to this structure than others. Developmental students are more likely to ask (and to do so with more sincerity) "How am I supposed to know what to study?" Obviously, the provision of clearly-stated instructional objectives resolves much of this confusion.

The idea that developmental students need the sort of structure and direction provided by clear and precise objectives is supported by Bernstein's study of low-achieving students and their performance in various types of classrooms (1976). His research suggested that those students who have the poorest academic records tend to improve their performance in classrooms where the instructor provides a high degree of structure and direction. Such students also tend to prefer strong and consistent reinforcement of whatever structure has been imposed. The degree of this preference, however, tends to increase with class size. As Keimig has pointed out, developmental students tend to "...achieve better in larger classes taught in a benevolently authoritarian manner (1983, p. 40)." In smaller classes clearly-stated objectives and precise instructions are still important but the constant reinforcement of instructions accompanied by an authoritarian manner are less important.

Donovan's 1975 study of successful developmental programs also suggested the importance of clear and precise objectives in effective instruction. All of the most successful instructional programs reviewed by Donovan were characterized by the specification of objectives and the regular reinforcement of these objectives. Insofar as developmental students are concerned, it appears that specification of clear and precise objectives is vital to successful instruction. Simply stating objectives, either orally or in writing, is, however, insufficient. Efforts must be made to insure that the objectives are clearly understood and that they are reinforced on a regular and consistent basis.

MASTERY

While an emphasis on mastery is clearly appropriate for developmental students, the use of self-pacing as a means of promoting mastery may have some disadvantages. Research indicates, for instance, that developmental students have a much higher drop out rate in totally self-paced courses than do other students (Sheppard and MacDermot, 1970 and Born, Gledhill and Davis, 1974). The same research indicates that developmental students who do drop out of self-paced courses do so without having completed more than a few of the required units. In essence, given the freedom to select their own pace, many developmental students select no pace at all.

Cross (1976) suggests that developmental students have trouble with self-paced courses because they lack both a self-concept of academic success and the self-discipline to be successful in less-structured courses. She claims that self-pacing works best when developmental students are given a chance to experience some early success in completing required course units. She also claims that lower-achieving students must be carefully monitored to ensure that they do make regular progress towards course completion.

It appears, therefore, that the self-pacing option in mastery learning may require some modification if it is to be successfully used with developmental students. A totally self-paced course is difficult for such students to manage if they lack academic self-discipline. If a self-pacing option is to be provided, it should be accompanied by opportunities for early success in completing units, a system for monitoring student progress, and a means of applying various contingencies to reinforce progress.

LEARNING STYLES

One of the basic maxims of learning is that all students learn in their own way and at their own pace. The theoretical assumption that adjusting instruction to accomodate individual learning styles will enhance learning is supported by some research (Canfield, 1980). There is disagreement among experts, however, as to just how individual learning styles should be accomodated.

Canfield proposes (Boylan, 1981) that attempts should be made to assess learning styles of students in each class and that instructional activity should be based on

the various styles represented by class members. McCarthy (1981), on the other hand, proposes that students are helped most when they are exposed to and expected to learn in several different styles. This will, in theory, allow students to excel when material is presented according to their particular style of learning. It will also require them to master styles of learning other than their preferred style. As yet, the research evidence is insufficient to determine with certainty which approach is more effective for developmental students.

Nevertheless, it seems clear that some assessment of learning styles is advantageous when working with developmental students. Such an assessment will accomplish at least two purposes: 1) it will enable students to understand how they learn best and, 2) it will enable instructors to determine the various learning styles represented by students in their classes. Given information about how they learn best, students should be able to adjust their study behavior to develop more efficient study habits. Given information about the learning styles of students in their classes, instructors can be more precise in designing alternative methods of presenting important course material.

Typically, instructors respond to the fact that students learn in different ways by randomly including alternative ways of presenting material in their courses. This approach is inefficient and, for developmental students, likely to be ineffective. Regardless of whether one believes that instruction should be adjusted to the individual styles of each student or that students should be forced to learn in several different ways, the assessment of learning styles is important. It will enable instructors to be far more systematic in their efforts and, in the long run, for more effective in accomodating individual learning styles.

TIME ON TASK

It is a reasonable assumption, and one generally supported by research, that the more time students put into learning tasks the more they will learn. Many developmental programs are designed according to this assumption. They provide all sorts of inducements and opportunities for students to put more time into learning via special drill sessions, programmed learning, tutorial services, and study labs.

The problem with this assumption and programs based upon it is that the resulting emphasis is on quantity of time spent rather than the quality of that time. As the research of Tobias (1982, p. 5) suggests, "What counts is how the student uses time and what the student is thinking while studying the materials." Tobias argues that students with low prior achievement need a great deal of instructional support to encourage them to become actively involved in learning tasks as opposed to simply looking at written passages or thoughtlessly completing workbook exercises.

Tobias cites activities such as constructing responses to possible questions and providing answer outlines for these questions as examples of active involvement in learning. On the basis of their research, Rosenshine and Stevens (1981) suggest that arranging for students to have a high percentage of correct responses in programmed learning activity, providing supervised drill and practice opportunities emphasizing thoughtfullness, and encouraging a focus on the academic applications of learning activity are much more related to improved performance than simply spending time reading material or filling in blanks in workbooks.

The key to the time-on-task issue is that time invested in learning activity should require an active involvement on the part of students. This is particularly true for students with prior records of low achievement. Simply listening to lectures or reading books has not worked before with these students, and there is no evidence to suggest that more of the same will produce better learning. Requiring developmental students to become actively involved in thinking about and processing material is much more effective than hav-ing them watch, listen, or read.

FEEDBACK FOR LEARNING

McKeachie (1965) was one of the most influential advocates of the importance of feedback for learning. His research clearly indicated that opportunities for feedback through class discussion tend to improve students' cognitive skills as well as their attitude toward courses and their

motivation to learn material (1965). This notion was also important to Bruner in his development of a theory of instruction (1966).

The value of feedback for the improvement of learning formed one of the basic components in Keller's Personalized System of Instruction (1968). Keller's emphasis on using classroom time for discussion and feedback has been carried through in most contemporary systems of individualized instruction. A considerable body of research on various individualized techniques (Mills, 1975; Smiley, 1975; and Bennet, Clements, Cookston, and Swindling, 1977) suggests that the provision of feedback on unit tests and opportunity to discuss test questions and responses is particularly beneficial to developmental students. It enables students to understand their mistakes and to correct any misunderstandings of the material.

In order for students to improve their learning, however, it is important for them to have information not only about what they have learned correctly but also what they have learned incorrectly. The importance of this for developmental students is often overlooked. Such students have frequently learned incorrect information in addition to failing to master appropriate skills. The impact of prior mislearning on the continued failure of developmental students is well documented (Shaughnessy, 1977). Often prior mislearning will lead to continued failure if inaccurate learning is not corrected.

While providing opportunities for feedback is an important component of instructional design, its importance for developmental students lies not only in improving current learning but also in the correction of past mislearning. For feedback to be used effectively with developmental students, therefore, it must focus on both current and past learning.

PREREQUISITE SKILLS

The instructional models of both Bruner (1966) and Glaser (1976) emphasize the importance of prerequisite skills in the mastery of new material. Indeed, the entire field of developmental education is based on a recognition of the importance of basic skills to the mastery of college-level material. In practice, this recognition usually translates to instruction and instructional support activities in the areas of reading, study skills, composition, and mathematics. Obviously, the mastery of these basic skills has a direct impact on success in college, but there is more involved in the prerequisite skill issue than emphasis on the basic content areas of academe.

For one thing, too many programs simply assume certain levels of unpreparedness in the basic skills and make minimal efforts to assess specific student weaknesses. Usually "prerequisite skills" are defined according to course content rather than according to what students need to add to their existing skill level in order to master course material. Obviously, serious diagnostic efforts are necessary to identify specific weaknesses and specific needs for additional knowledge. Only after such diagnosis takes place can attention be directed towards the development of specific prerequisite skills.

A second consideration in the area of prerequisite skills is the importance of logic and critical thinking as prerequisites to further learning. The importance of logic and critical thinking skills for developmental students is well documented in the research of Whimbey (1975). On the basis of his study of low achieving students, Whimbey found that practically all of them lacked the thinking skills necessary to master college-level material. He also found that simple training in basic thinking skills led to considerable improvement in academic performance.

Attention to the development of prerequisite skills is obviously important in developmental instruction. Instructional activities designed to attend to the need for such skill development, however, must be based on accurate diagnosis of specific student weaknesses. Some emphasis on the development of thinking skills in addition to whatever other skills are to be taught must be included.

SUMMARY

In reviewing the research on theory-based components of effective instruction, several applications are apparent for developmental students. Each of the theory-based components has merit. Yet each of them must be applied with caution if they

are to result in more effective learning for developmental students.

The implications of this particular review of instructional theory and research may be summarized in the following series of "Yes... but" statements:

* YES, instructional objectives are important BUT they must be clearly stated and reinforced with regularity and consistency.

* YES, self-pacing is important for mastery BUT pacing should be carefully monitored and regular progress should be reinforced.

* YES, learning styles should be accomodated BUT accomodation should be based on assessment rather than random inclusion of alternative learning activities.

* YES, time on task is important BUT the level of students' active involvement in learning tasks is far more important than the amount of time spent.

* YES, feedback is important for learning BUT feedback should be aimed at correcting prior mis-learning as well as current mistakes.

* YES, emphasis on the development of prerequisite skills is important BUT this emphasis should be based on individual diagnosis and thinking skills should be considered as a critical prerequisite to further learning.

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Research in Developmental Education

Volume 1
Issue 4

The Effects of a Skills Versus Discussion Approach on Reading and Thinking

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IN THIS ISSUE

Author Joan Bartlett compares the effectivness of two instructional techniques on reading comprehension.

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Developing student reading comprehension is a continuing problem for instructors. In order for them to address this problem they must first understand the reading process.

Reading involves recognizing thoughts expressed by words themselves or, in technical terms, literal level skills. Facts, however, are just one part of comprehension. Reading comprehension also requires going beyond the information given to draw ideas from an assortment of facts. This process of going beyond the established facts to draw inferences is called "inferencing."

The ability to infer from factual material is an index of the ability to think in abstract terms. Inferencing, therefore, is one of the learning skills critical to success in postsecondary education.

Inferencing is a process that takes place regularly in reading. As students read a text, they are confronted with a network of facts which constitute a pattern of information. This pattern leads them to consider the message in terms of the total network rather than as single ideas in the text. Drawing inferences from facts is actually a very common occurrence in reading and in everyday life. It involves reflection and critical thinking. The ability to engage in reflection and critical thinking generally develops with age, according to Heatherington and Parke (1975). Piaget places the ability to infer (to think abstractly) at the stage of cognitive development - the formal operational stage. He proposes that formal operations normally begins to develop at age twelve.

From the Piagetian theoretical perspective, high school and college students are capable of moving past the literal, factual level and thinking at the abstract and critical levels. Practically speaking postsecondary developmental educators realize this is not the case for many college students or that, for many students, such abilities are only partly developed. This reality is confirmed by the National Commission on Excellence in Education (1983) report stating that 40% of the seventeen year olds in the United States cannot make inferences from printed material.

With this in mind, this issue of RESEARCH in DEVELOPMENTAL EDUCATION is devoted to a review of the research on reading comprehension and inferencing and a study of two different instructional approaches and their impact on reading and thinking. A brief review of the relevant literature is followed by a detailed description of a study designed to assess the relative merits of a skills approach, a discussion approach and a traditional lecture approach on the development of reading and thinking skills.

THE INFERENCE PROCESS

Bartlett (1951) suggests that, "Whenever anyone interprets evidence from a

source, and the interpretation contains characteristics that cannot be referred wholly to direct sensory perception, this person thinks." Spearman (1923) considers this process to be the most important characteristic of mental life.

Bartlett (1932) sees the inference process as constructive in that it builds conclusions from the accumulation and personal organization of individual facts. Many years after Spearman's and Bartlett's initial investigations of the inference process, Goetz (1977) also interprets inferencing as a constructive process. His views are shared by Paris (1975) who proposes that inferencing is a means of expanding what is already known. Paris believes that human beings elaborate on initial knowledge by seeing relationships form among facts.

According to the Piagetian model, inferencing might be considered a component of the assimilation process. When inferencing takes place, new information is incorporated with relevant ideas that are already formed and perceived as important. Understanding, according to this model, comes with the ability to mentally elaborate on ideas as a result of making relevant connections.

COGNITIVE ABILITY AND READING

It is a generally established fact within the educational community that cognitive ability is closely related to the reading ability measured by standardized tests. Belmont and Birch (1966) report a high correlation between intelligence and reading test results. They do not,however,differentiatespecific components of comprehension in their study.

Mosley (1978) reports research indicating that students who obtain high scores on intelligence tests also tend tc score high on questions requiring subjects to draw inferences. She also reported that brighter students tend to make more inferences but they do not perform as well as less bright students on questions limited to the identification of facts. Conversely, students who have lower scores on intelligence measures perform poorly on inferential test items.

INFERENCE EXPERIMENTS WITH COLLEGE-LEVEL STUDENTS

It is important to note that variables in learning tasks also make a difference in inferencing skills. Smith, for instance, studied the effects of questioning strategies on the development of inferencing skills and found that the way in which questions are asked have an effect on the way students form responses (1977). Convergent questions tend to direct students to form answers in a step-by-step process. Evaluative questions encourage decision-making skills, while divergent questions direct students to produce a variety of responses. Using these three questioning strategies, Smith taught three groups of freshmen at an open admission university and compared their performance with control groups taught by using exercises on recognizing topics and outlining major ideas. All of the experimental groups appeared better able to make inferences than the control groups The experimental groups seemed to do even better, however, with questions based on evaluative and divergent processes.

In a related study, Friedman (1977) used different types of questions involving verbatim recall, paraphrasing, and inference questions as study guides for a psychology class. In class examinations students who were required to respond to inferential level questions while studying had significantly higher mean scores than students who had used study guides requiring either verbatim recall or paraphrasing. Those who responded to questions requiring paraphrasing also had significantly higher mean scores than those who were required to use the exact words of the text in responding to study questions.

A TEST OF INSTRUCTIONAL APPROACHES

Given the research on reading and the inference process, it was assumed that some approaches to instruction would result in greater improvement in comprehension and thinking skills than others. To test this assumption, two instructional approaches were selected: the SKILLS approach and the DISCUSSION approach. The skills approach was patterned after Barrett's taxonomy of thought levels (1972). In this approach, reading

was taught in a series of explicitly-stated thinking levels which proceeded from literal to progressively more difficult inferential, evaluative, and appreciative levels. Students first worked on recognizing and recalling ideas, information and happenings as they were explicitly stated in the material. After several exercises of this nature, students were guided to infer by using a combination of factual content, personal knowledge, intuition and imagination. Evaluation was then demonstrated by having students make judgments about the facts presented through comparison with other information sources such as the instructor, experts in the field, past experiences or knowledge and values related to the material. Finally, appreciation was demonstrated by discussing how authors bring about emotional responses in readers.

The second method used in this study was the discussion approach. This approach, patterned after Mosley's model of comprehension (1979), did not proceed in a series of steps. Rather, it attempted to generate comprehension through an unfixed sequence of components.

The Mosley model was based on the ideas of several researchers in the fields of reading and learning. Those credited by Mosley include Barrett (1967), Bloom (1956), and Taba (1962.

Mosley proposes three major categor-ies of comprehension: 1) literal - explicit, 2) inferential-implicit, and, 3) creative-judgmental. The literal - explicit category involves reading for facts. The inferential-implicit category involves drawing conclusions from the information presented. The creative-judgemental category involves creating unique relationships among ideas presented in the text and ideas already acquired through reflection.

In initial lessons of the discussion approach, students were encouraged to relate their own experiences to the factual information they read. They were not asked to identify main ideas and details. Rather, the instructor guided students in finding relationships between what they already knew and what they were reading. The activity was student-centered with the students forming appropriate questions, recognizing consistencies and contradictions, analyzing values, discovering alternatives and, in general, using all their thinking skills from the very beginning of the course. Eventually, an atmosphere of intellectual curiosity developed, and the philosophical importance of an issue often became the topic for discussion.

METHODOLOGY

Students were randomly selected for inclusion in the classes from a total pool of 155 who were average or below average inferential readers as measured by the Stanford Diagnostic Reading Test, Level III, Form A. The students were divided into three groups: the skills approach group and the discussion approach group, and a traditional group participating in regular English classes.

The skills approach group participated in classes where skills were addressed sequentially as in the Barrett model. Instructional objectives for this group included:

* Identifying main ideas from sentences and paragraphs (Literal level at the beginning of the course).

* Infering the main idea when it is not directly stated (Inferential level at the middle of the course).

* Distinguishing between material which is fact and material which is opinion (Evaluative level at the middle of the course).

* Identifying characters or incidents by recalling life experiences (Appreciative level at the end of the course).

The discussion approach was conducted using the Mosley model with objectives for classes tapping all levels of reading taxonomies. Objectives were adopted from Lipman's "Philosophy for Children" program (1978). Sample objectives included:

* Formulating concepts precisely

* Making appropriate generalizations

* Identifying underlying assumptions

* Taking differences of perspectives into account.

There were sixteen class meetings, two a week for eight weeks, for each of the "intervention groups." The term "intervention" is used here because the reading instruction was condidered to intervene in the students' regular program of study. The traditional group students remained in their regular English classes.

All students were tested on dependent variable measures such as literal level reading comprehension, high level inference performance, low level inference performance, vocabulary skills and critical thinking ability. Measurement of literal level reading and vocabulary skills was accomplished via the appropriate sub-tests of the Stanford Diagnostic Reading Test. High and low level inference items were determined by having reading specialists rate each item of the inference sub-test of the Stanford Diagnostic and establishing inter-rater consistency at a statistically significant level. This rating also yielded two other post test instruments. Critical thinking was measured by the Cornell Critical Thinking Test, Level X.

In a study of this nature, it is necessary to make sure that the experimental groups do not show greater post test scores simply because they included better students in the first place. A covariate analysis was used to partial out these initial differences. The pre test low level inference scores seemed to be a suitable covariate because they represented a combination of literal level skills and skills beyond the literal level that might give some students a preliminary advantage in this type of experiment. Given these considerations, the major statistical test used was the multivariate analysis of covariance or MANCOVA (Tabachnick and Fiddel, 1983).

RESULTS

Students in both intervention groups performed significantly better than the traditional groups on all performance measures. There were no statistically significant differences between students in the two intervention groups. However, the mean socres of the discussion approach group were slightly higher than the skills approach group. The students assessed as having high cognitive ability performed better than low ability students on all measures except high level inference items.

An interaction was also found between ability and approach on the critical thinking measure. This interaction effect showed that the discussion approach was more beneficial for low ability students than the skills approach. The means of both the discussion and the skills approach groups were also significantly greater than the means of either high or low ability students in the traditional group.

SUMMARY AND CONCLUSIONS

The major conclusion of this research study is that systematic intervention involving either a skills approach or a discussion approach appears efficacious to the reading comprehension achievement of older students regardless of ability level. The discussion approach may improve reading comprehension slightly more than the skills approach. This appears to be a result of the fact that higher order skills were addressed from the outset of the course in this approach. With the skills approach, students were made to wait before venturing beyond the facts and they did not evaluate material critically until the final stages of the intervention.

The only area in which there were statistically significant differences between the two approaches was critical thinking. The discussion approach appeared to have greater positive impact on critical thinking for low ability students than the skills approach. This result is in conflict with Bloom's mastery learning theory for slow learners. However, Bloom's work (1976) is based on studies of elementary students and may not, as a result, be generalizable to college level students.

A number of the findings from this study have practical implications for the improvement of instruction for older students. These are summarized below.

1. Reading comprehension instruction for average and below average learners

should not be limited to the elementary levels. Rather, it should be continued at the secondary and postsecondary levels.

2. The skills approach does not seem to improve critical thinking in older students who are considered to be either slow learners or poor readers. Although this approach has been popularized by Bloom, its applicability may be limited to younger students.

3. Initial reading instruction with poor readers should include discussion of concepts, identification of assumptions, and other generally-accepted higher order thinking skills rather than instruction in recognizing and recalling factual information alone.

4. Quizzes and tests should include inferential, evaluative and appreciative level questions — not just literal level questions.

5. Research on the effects of and comparisons of instructional models should be built into regular classroom instruction.

As in so many other attempts to analyze original data from a study, this study seems to raise as many questions as it answers. No research is truly conclusive. The methods used in modern educational research were conceived in the field of physics and adopted by the social sciences. Whenever they are applied, they remain at least as imperfect as the human beings who created them. Nevertheless, studies such as this one and others like it can be of considerable value in improving college level instruction — particularly for underprepared college students.

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Research In Developmental Education

Hunter R. Boylan, Editor

The Effectiveness of Developmental Education Programs

By: Hunter R. Boylan

Since the mid-1960's developmental programs designed to help underprepared and non-traditional students become successful in college have proliferated rapidly. Roueche and Snow (1978) estimate that 95% of community colleges and 76% of 4 year institutions presently offer such programs. Estimates also suggest that there are between 25,000 and 35,000 faculty and staff working full or part-time in developmental programs on college campuses. According to the Carnegie Council on Policy Studies in Higher Education, about 8 million students are attending colleges and universities in the United States and 10 to 15% of these students are enrolled in one or more developmental courses or services (1980). This suggests that approximately one million students are participating in developmental programs across the nation.

Given the rather substantial investment that postsecondary institutions have made in developmental education, it is reasonable to ask if these programs are actually effective in helping underprepared students succeed in college. While developmental educators frequently evaluate their efforts on a program by program basis, until recently, most reports on the effectiveness of developmental education have been limited to individual programs. There has been limited research regarding the effectiveness of developmental education in general.

Within the past few years, however, researchers have started to look at data from a variety of different programs in an effort to determine the general effectiveness of developmental education activities. This issue of RESEARCH in DEVELOPMENTAL EDUCATION, is devoted to a review of recent research on the effectiveness of developmental education or other programs for students designated as "high risk."

GRADE POINT AVERAGES

The most recent and extensive study on the effectiveness of programs for high risk students was conducted by Kulik, Kulik, and Shwalb at the University of Michigan's Center for Research on Teaching on Learning (1983). This study analyzed the results from 60 separate evaluation reports using the technique of meta-analysis. This technique is specifically designed to summarize a variety of research reports and relate the characteristics of these reports to outcomes. It is particularly useful for drawing general conclusions from a wide variety of reports using different methodologies.

Fifty-seven of the sixty studies reviewed by Kulik, Kulik and Shwalb investigated grade point averages of special program students as compared to control groups of similar students not participating in such programs. Of these studies, forty-four reported higher grade point averages for those enrolled in special programs. Seventeen of these reports cited statistically significant differences in favor of those participating in special programs. Only one of the studies reviewed reported statistically signifi-

cant differences in favor of the control group.

The authors found that, on the whole, the grade point average for those participating in special programs was 2.03 while the average for those not participating was 1.82. The authors point out that while this difference is statistically significant, it is, nevertheless, a relatively small one (Kulik, Kulik, and Shwalb, 1983).

A report commissioned by the National Association for Developmental Education (Boylan, 1983) also investigated the effect of developmental programs on grade point averages of participating students. In this report, the author reviewed the findings of evaluation reports from fourteen college and university developmental education programs. Of the studies reviewed, twelve reported higher grade point averages for those participating in developmental programs than for similar students who did not participate. It should be noted, however, that two of the studies reviewed did not include control groups.

Boylan's review also suggested that, 1) developmental students tend to improve their grades during the semester following participation in developmental programs and, 2) those participating in developmental programs tend to obtain much higher grades than admissions predictors such as high school grades and achievement test scores would indicate (1983).

RETENTION RATES

The Kulik, Kuilik, and Shwalb study cited above also investigated the impact of special programs for high risk students on the retention rates of these students. The authors reviewed thirty studies which examined the effect of such programs on the retention rates of their clients. Of these thirty studies, twenty-one reported a consistently higher rate of retention for program participants than for non-participants. In five studies, the reported retention rate was higher for non-participants while, in four studies, persistence rates were identical for both groups (Kulik, Kulik, and Shwalb, 1983).

In 1982, the U.S. General Accounting Office (GAO) undertook a study of Special Services Programs funded by the U.S. Department of Education. The GAO report investigated ten Special Services Programs and found inconclusive results. Five of the programs studied reported no significant differences in retention between program participants and non-participants. Five of the programs reviewed reported a statistically significant difference in retention favoring the program participants. In no case was the retention rate for program participants lower than for non-participants (GAO, 1982).

In response to this GAO report, the U.S. Office of Education cited its own data on retention rates for Special Services Program participants. According to the Office of Education, the retention rate for program participants during the three year period of 1978 to 1981 was 67%. This compares quite favorably with the national average for student retention over a three year period which is generally considered to be less than 50%. The Office of Education also cited data from an in-progress evaluation of Special Services Programs conducted by the Systems Development Corporation. According to this report, students receiving a full range of special services had "... predicted odds of persisting (through the freshman year) 2.26 times the odds for students who received no such services (US Office of Education, 1982).

In the Boylan study of developmental programs, seventeen reported figures on student retention. Of these, all seventeen indicated that retention rates for program participants were higher than for non-participants. There were, however, substantial differences in retention rates reported from program to program. The average two year retention rate reported was 66% while retention figures ranged from 55% to 90% (1983).

GAIN SCORES

A measure of impact frequently used but seldom reported by developmental programs is the gain score. The gain score reflects the degree of improvement made by students from pre-test to post-test on some standardized instrument.

A study undertaken by the Institute for Services to Education and reported by Donovan (1975) assessed the gain scores of

Resourcery

The forthcoming conferences listed below may be of interest to developmental educators.

February 28 to March 1, 1985

Reasoning and Higher Education Conference - Boise, Idaho

Sponsored by: The Center for the Study of Thinking, Boise State University, Boise, ID

March 7 to March 9, 1985

Ninth Annual Conference on Developmental Education - St. Louis, Missouri

Sponsored by: The National Association for Developmental Education, Contact Ms. May Garland, Center for Academic Development, University of Missouri, 5100 Rockhill Road, Kansas City, MO

March 28 to 31, 1985

Western College Reading and Learning Association Conference Denver, Colorado

Sponsored by: The Western College Learning & Reading Association Contact Mitchell Kaman, Larimer County Vo-Tech Center, P. O. Box 2397, Fort Collins, CO

April 14 to 16, 1985

Eighth Annual Symposium on Remedial/Developmental Education Niagra Falls, New York

Sponsored by: The New York College Learning Skills Association Contact Gail Gucker, Learning Development Center, Rochester Institute of Technology, 1 Lomb Memorial Drive, Rochester, NY

April 18 to 20, 1985

Annual Conference on Developmental Education - Harrisburg, Pennsylvania

Sponsored by: The Pennsylvania Association of Developmental Educators, Contact Samuel Hirsch, Community College of Philadelphia, 1700 Spring Garden Street, Philadelphia, PA

students enrolled in remedial English, mathematics, and science courses at thirteen colleges and universities. Using standardized testing instruments in all three subject areas, the investigators found a consistent postive gain from pre-test to post-test for students participating in developmental programs. A comparison of pre and post-test results for program participants versus non-participants also showed a statistically significant difference in gain scores favoring the program participants.

Boylan's study of developmental programs (1983) found eight programs reporting gain score data for students. Each of these studies reported strong gains from pre-test to post-test for those participating in developmental courses. A review of these studies suggested the following general trends: 1) those who enroll in basis skills courses show measureable gain scores from pre-test to post-test, 2) those who enroll in basic skills courses show greater gains from pre-test to post-test than those who do not, and 3) underprepared students enrolled in basic skills courses often score higher on standardized post-tests than better-prepared students who took the test but who did not enroll in the basic skills course (Boylan, 1983).

OTHER FACTORS

While grade point averages, retention rates, and gain scores appear to be the most common measures applied to the evaluation of developmental programs, such programs also yield other, less measureable outcomes. The U.S. Office of Education report, for instance, cites numerous instances of students leaving college having accomplished their objectives but without completing a degree. Such instances had a negative impact on retention figures even though they represented a success for the students.

In many cases, program services were also instrumental in helping students to make career and life planning decisions which were quite productive for the individuals involved. Unfortunately, these decisions often resulted in students leaving college and were thus counted as "losses" insofar as retention was concerned (U.S. Office of Education, 1982).

Another factor identified in the Boylan study (1983) was that those who participate in developmental programs tend to obtain higher grades than expected. Five of the studies reviewed by Boylan indicated that students participating in developmental programs tend to do much better academically than admissions predictors would suggest. While this difference between predicted and actual performance may be due, to some degree, to the inaccuracies inherent in such predictors, the differences noted were consistent and statistically significant.

PROGRAM VARIABLES

In all of the studies reviewed, there were substantial differences in performance from program to program. In assessing these differences, Kulik, Kulik, and Shwalb (1983) found that students who began their participation in developmental education early in their academic careers or even prior to college entry tended to perform much better than students who participated in such programs later on. Apparently, those programs which emphasized early intervention tended to be more successful than those which did not.

The authors also found a direct correlation between entry level skills and student success. Specifically, the developmental students with higher grades and placement test scores tended to benefit more from program services than those with lower grades and placement test scores.

In addition, Kulik, Kulik, and Shwalb also noted a consistent difference in success rates between new programs and old programs. Apparently, the longer a program was in existence, the more likely it was to show positive outcomes for student participants (1983).

Both the GAO report (1982) and the Boylan report (1983) found a direct correlation between the range of services provided by programs and the degree of success experienced by students in those programs. Apparently, the more comprehensive a program was, the more likely students were to be successful following participation. These findings are consistent with those of Roueche and Snow in their study of twelve "model" developmental education programs (1978).

DISCUSSION

Recent research on the effectiveness of developmental education programs lends overwhelming support to the notion that such programs are, indeed, successful in their efforts to assist underprepared college students. The studies reported here are quite consistent in suggesting that:

1. Students participating in developmental programs tend to earn higher grades than similar students who do not.

2. Students participating in developmental programs tend to be retained at higher rates than students who do not.

3. Students participating in developmental programs tend to show greater gain scores on standardized tests than students who do not.

These results from recent studies are not consistent with many earlier reports on developmental education programs. Santeusanio, for instance, found no relationship between participation in developmental programs and grade point averages in his 1974 study. Cross (1976) also investigated the effects of developmental programs and found mixed results. Similarly, Summers (1970), Tilman (1973), and Raygor (1974) found little evidence that participation in developmental programs was directly related to success in college.

These differences may be explained by the Kulik, Kulik, and Shwalb finding that mature programs had better success than new programs (1983). Developmental programs are a relatively new phenomenon on college and university campuses. Most were established between 1965 and 1975 (Roueche and Snow, 1978). Research undertaken in the early 1970's would, therefore, have investigated the effect of relatively young developmental education programs. Recent research, on the other hand, would be more likely to investigate the effects of mature programs.

The present-day developmental program is likely to be more sophisticated than those of the 1960's and 1970's. As developmental programs have proliferated, new techniques for serving students have been developed and old techniques have been refined and improved. As programs continue on a given campus, additional services are generally included in the program offerings. This results in a more comprehensive program and, hence, one that is more likely to be successful.

Furthermore, as programs mature, program staff gain more experience. Even when there is staff turnover, many of the staff who leave a given program simply go to work in another developmental program. The pool of developmental educators in the U.S. may, therefore, be more experienced and and more knowledgeable of techniques for working with developmental students than they have been in the past.

For whatever reasons, however, recent research suggests that developmental programs of the 80's are effective in helping underprepared students to succeed in college. Present-day programs also seem to be more effective in accomplishing this goal than earlier programs and this effectiveness seems to be consistent for most developmental programs.

The degree of this effectiveness is, however, far from uniform. Some programs appear to do an exceptional job of improving student gain scores, grade point averages, and retention. Others contribute only slightly to student improvement in these areas. The research shows quite clearly that developmental education can, indeed, work. Additional research is needed, however, to determine exactly what it is that makes certain programs work better than others.

NOTE:

For a discussion of the characteristics of successful developmental education programs, see the following issues of RiDE:

"Characteristics of Successful Programs," Spring, 1983.

"Developmental Instruction: What Really Makes a Difference," Part I, Fall, 1983.

"Developmental Instruction: What Really Makes a Difference," Part II, Winter, 1984.

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Research In Developmental Education

Hunter R. Boylan, Editor

Facts, Figures, and Guesses About Developmental Education Programs, Personnel and Participation

By Hunter R. Boylan

While developmental education programs have expanded rapidly on college and university campuses since the mid-1960's, there are few single sources of data regarding the current scope and size of developmental education activities in American postsecondary education. Several national studies have provided information on the percentage of institutions offering developmental courses, the types of courses offered and the structure of developmental programs (Cross, 1976, Roueche and Snow, 1977, and Wright, 1985). Most of these, however, have dealt with program organization and delivery and have used sample populations. Since the focus was on program variables and only samples were used, we have little information on such things as the number of faculty involved in developmental education, the number of students participating, and the number of programs in operation on college and university campuses.

The purpose of this issue of RiDE is to assemble data from a variety of sources to develop a statistical base for discussion of the current status of developmental education activities in the United States. In some cases, exact data is available from research reports and statistical digests. In others, exact data is not available and some projections or guesses are required to generate estimates of programs, personnel, and participation. It is hoped that this issue of RiDE can be used as a data source for those who need to know some of the basic statistics about the field of developmental education.

Faculty Involved in Developmental Education Courses

While several attempts have been made to determine the percentage of colleges and universities offering developmental courses, little information is available on the number of faculty actually involved in the teaching of these courses. The College Marketing Group of Winchester, Massachusetts, however, is in the business of identifying faculty teaching various courses. This information is then used for textbook marketing. Within the last few years, they have used a number of survey and response techniques to determine the number of faculty who teach basic skills courses. A summary of their most current report on this topic is provided in TABLE I.

According to this data, there are about 26,000 college and university faculty members teaching in some area of developmental education. Of these, the largest group of instructors is involved in teaching basic grammar and composition. Just over 9,000, or 35% of the total number of those instructors teaching developmental courses, are teaching grammar or composition. When those who teach English as a

second language are added to this group, the percentage of developmental educators involved in English instruction increases to 46% of the total population. Since many of those who teach reading or study skills courses are also housed in English departments, the percentage of developmental educators affiliated with English departments is probably even greater than 46%.

While English grammar and composition courses probably occupy the greatest number of developmental educators, mathematics instruction is a close second. A total of 8,348 instructors, or 31% of all developmental instructors, are involved in the teaching of remedial or developmental mathematics.

Reading and study skills are taught by the smallest number of developmental instructors, although it is likely that some overlap may exist between those who teach basic grammar and composition and those who teach reading and study skills. If reading and study skills are combined, 5,689 or 21% of the total are involved in teaching these courses.

As might be expected, the majority of remedial and developmental instruction takes place on 2-year college campuses. Nevertheless, there are still a large number of 4-year college faculty who are engaged in remedial and developmental instruction. In fact, the 10,931 4-year college faculty reported represent about 42% of all those engaged in developmental education.

Two-year college instructors of remedial and developmental courses outnumber 4-year college instructors in all areas except for two: English as a second language and introduction to college mathema-

TABLE I

NUMBERS OF FACULTY TEACHING BASIC SKILLS COURSES

Subject	2-Year	4-Year	Total
Basic Grammar and Writing	5,153	3,991	9,159
Remedial Reading	3,218	1,193	4,421
Study Skills	902	366	1,268
English as a Second Language	1,337	1,635	2,972
Basic & Remedial Mathematics	1,206	814	2,020
Basic Arithmetic	2,133	1,070	3,203
Introduction to College Mathematics	1,263	1,862	3,125
Totals	15,212	10.931	26,143

Source: College Marketing Group, Worchester, Mass., 1985

tics, This should not be surprising given the large number of international students attending 4-year institutions in the United States or the large number of 4-year institutions requiring mathematics as part of a common curriculum for all students.

It should be noted, however, that the 26,143 figure reported here does not include all those involved in remedial and developmental education. It includes only faculty who are charged with regular teaching responsibilities. Counselors and administrators who are not actually teaching courses on a regular basis are not included.

Sullivan's Guide to Learning Centers in Higher Education (1979) reports that there are 1,374 postsecondary institutions in the United States offering non-instructional developmental services. Roueche and Snow (1977) report that 64% of the nation's 2-year institutions and 51% of 4-year institutions provide at least one full-time counselor for developmental students. Furthermore, 53% of 2-year institutions and 44% of 4-year institutions have full-time administrators managing developmental programs.

Consequently, it is reasonable to assume that there must be several thousand non teaching personnel involved in developmental programs across the country. A reasonable estimate would be that, in addition to the 26,143 faculty members involved in developmental education, another 5,000-10,000 administrators, counselors, and other support personnel are probably working in developmental programs across the country. An educated guess regarding the number of developmental education personnel in American postsecondary eduction, therefore, would run somewhere between 30,000 and 35,000.

Student Participation in Courses

Another piece of data that may be of interest is the percentage of students taking various remedial and developmental courses. This topic was investigated by Wright (1985) through a "Fast-Response Survey" sponsored by the National Center for Education Statistics. A break-down of these results is presented in TABLE II.

It is interesting to note that while the largest number of faculty appear to be involved in teaching remedial and developmental English, the largest number of students appear to be taking remedial and developmental mathematics courses. This is understandable in light of the fact that English courses, as a general rule, tend to be smaller than mathematics courses. While more students may, indeed, require remediation or development in mathematics, their needs may be accomodated by fewer faculty. Furthermore, individualized instructional techniques as well as computer-assisted instruction can be used more effectively in remedial and developmental mathematics courses than in English courses. As a result, fewer faculty can teach more students in the area of mathematics.

It is also worth noting that there do not appear to be any significant differences between types of institutions and the percentage of students requiring remediation in various subjects. In English, for instance, the enrollment percentage range for all types of institutions is only three points. The same is true for enrollment in remedial and developmental reading. In mathematics, the percentage ranges from 27% for 4-year private institutions to 32% for 2-year public institutions. In short, remedial and developmental courses appear to be as necessary in exclusive 4-year institutions as they do in open admissions 2-year institutions. Of course, the level work considered to be remedial or developmental may, indeed, differ among various types of institutions.

Total Students Participating in Developmental Programs

According to a recent issue of the CHRONICLE OF HIGHER EDUCATION, there are 12,247,000 students enrolled in colleges and universities for the Fall of 1985. Of these, approximately 4,500,000 are freshman (NCES, 1985). The National Center for Education Statistics reports that about one-fourth of all entering freshmen are enrolled in remedial or developmental courses in English, reading, and mathematics. This would mean that about 1,125,000 freshmen students are enrolled in remedial or developmental courses.

This estimate of 1,125,000 students does not, however, represent all those who may be participating in remedial and de-

TABLE II

Average Percent of Freshmen Enrolled in Remedial or Developmental Courses

Subject Area and Type of Institution	Percent of Students Enrolled
Reading	
All Institutions	23
Public	22
Private	23
2-year	24
4-year	21
Writing	
All Institutions	25
Public	26
Private	24
2-year	28
4-year	23
Mathematics	
All Institutions	30
Public	31
Private	28
2-year	32
4-year	27

Source: Wright, D.A., NCES, 1985

velopmental courses. The number refers only to freshman. Neither does this number include those students who may not be enrolled in courses but may be participating in some other services offered by developmental programs such as tutoring, counseling, or advising. When one considers the fairly large number of upperclassmen enrolled in remedial and developmental courses and the number of students who may be using developmental services other than classes, the figure of 1,125,000 is probably an inaccurate estimate. It is likely that closer to 2,000,000 or more students are participating in some aspect of developmental education.

Summary

The statistics and estimates presented here suggest that remedial and developmental education programs may be more widespread in postsecondary education than most people realize. Somewhere between 26,000 and 35,000 professionals are likely to be involved in developmental courses and support services. Somewhere between 1,125,000 and 2,000,000 students are likely to be participating in these developmental courses and services.

The majority of instructors involved in developmental education are teaching grammar and composition courses while a slightly smaller number teach remedial and developmental mathematics courses. The teaching of remedial and developmental reading apparently involves the fewest number of instructors.

The largest percentage of remedial and developmental students are enrolled in various kinds of mathematics courses. The next largest enrollment percentage is in English, while reading represents the third-largest percentage. The differences in enrollment percentages are, however, slight. Overall, 30% of entering freshmen are enrolled in remedial or developmental mathematics courses, while 23% of them are enrolled in remedial or developmental reading courses.

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